FAA Proposed Solar Radiation Alert

Space Weather Week

20 May 2003

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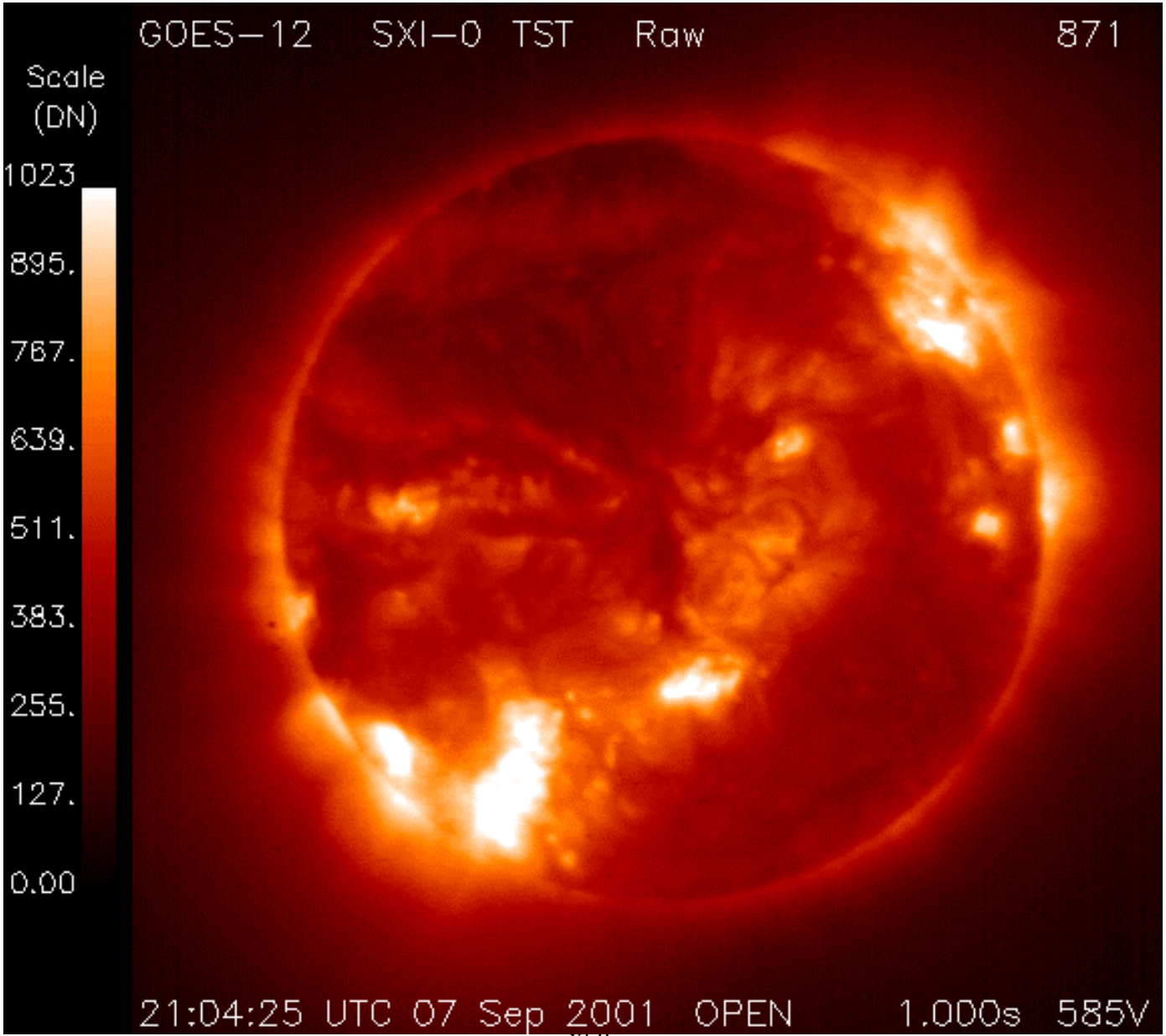
Office of Aerospace Weather Policy and Standards


GOES-12 SXI-0 TST Raw 871
Scale (DN)
1023
895.
767.
639.
511.
383.
255.
127.
0.00
21:04:25 UTC 07 Sep 2001 OPEN 1.000s 585V

Radiation Exposure of Air Carrier Crewmembers - FAA AC 120-52

- RADIATION EXPOSURE OF AIRCREWS AND RECOMMENDED LIMITS
  - **The recommended annual limit for occupational radiation exposure of an adult is 50 millisieverts (5 rem) (EPA 1987).**
  - **Pregnant crewmembers - the dose equivalent to the unborn child from occupational exposure should not be ore than 0.5 millisievert (50 millirem) in any month (NCRP 1987a).**
- RISK TO CREWMEMBERS
  - **Death from cancer is the principal health concern associated with occupational exposure to radiation.**
  - **Normal expectation for the U.S. adult population, about 220 of 1000 crew members would die of cancer from causes unrelated to occupational radiation exposure.**
  - **Aircrew members can expect an increased risk of death by cancer on the order of 1 in 360 associated with occupational radiation exposure.**

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- **Earth's magnetic field provides some shielding**
  - **Greatest shielding is over the geomagnetic equator**
  - **Shielding decreases closer to the poles with little or no change above 50° geographic latitude in North America.**

- **Earth's atmosphere also provides some shielding**
  - **Galactic radiation at 1,200 ft. MSL is approximately one-half of one percent of the levels at 39,000 ft. MSL.**

Biological Effects

- Unit of measure
  - 1 Sievert (Sv)=100 rem
  - 1 Sv = 1000 mSv
  - 1 mSv= 1000 μSv
- Location, Location, Location
  - Altitude, latitude and time dependent
- Solar cycle

Solar Cycle

- 11-year Solar cycle
  - Last maximum occurred Apr 2001
- Radiation from two sources
  - Galactic (cosmic) and Sun (energetic particles)
  - Predominant source dependent on solar cycle
- Cosmic radiation effects are maximum when solar activity is minimum and vice versa

Radiation at Altitude

- Last solar minimum cosmic radiation 4μSv/hr at 30K ft at 70N and 3.25 at 35N
- During solar maximum rate fell to about 3μSv/hr at both latitudes
- July 2000 solar particle event – 50 μSv/hr extending over almost a full day at altitude

Radiation Limits

- Maximum permissible dose 1000μSv/yr (GP)
- MPD 50,000 μSv/yr for aircrew
- Sea-level exposure of about 6-12μSv/day
- Two-hour flight 20-40K ft - 12-24μSv/day
- During solar max it is possible for a solar event to produce a dose rate of up to 200μSv/hr for a few hours at airliner altitude

Physiological Impacts

- Cancer – leukemia, melanoma, prostate
- Cataracts
- Fetal damage – physical, mental, death
- Chromosomal damage – Concorde/U2 pilots

Calculating Radiation Exposure

- CAMI-6/6M computer programs:
  - http://jag.cami.jccbi.gov./cariprofile.asp
  - Calculates effective dose of galactic radiation received on an aircraft flying a great circle route (CARI-6) or a user-defined route (CARI-6M)
  - Between any two airports
  - Program accounts for effects of changes in earth's magnetic field and solar activity

Forecasting and Alerts

- CAMI developed plan for alerting on events of at least 20 μSv/hr and remaining at or above that level for at least 15 minutes
  - Currently available on:
  - password controlled FTP site for “pull” by airlines
  - FAA Weather Message Switching Center using and SEC supplied WMO message header. (WOXX50)

CAMI Recommended Alert Responses

- Long-lived event (hours)
  - Aircraft in flight – descend below 40K ft
  - Aircraft on ground – add fuel and change alt
- Short-lived event (minutes)
  - Aircraft in flight – descent recommended
  - Aircraft on ground – no action

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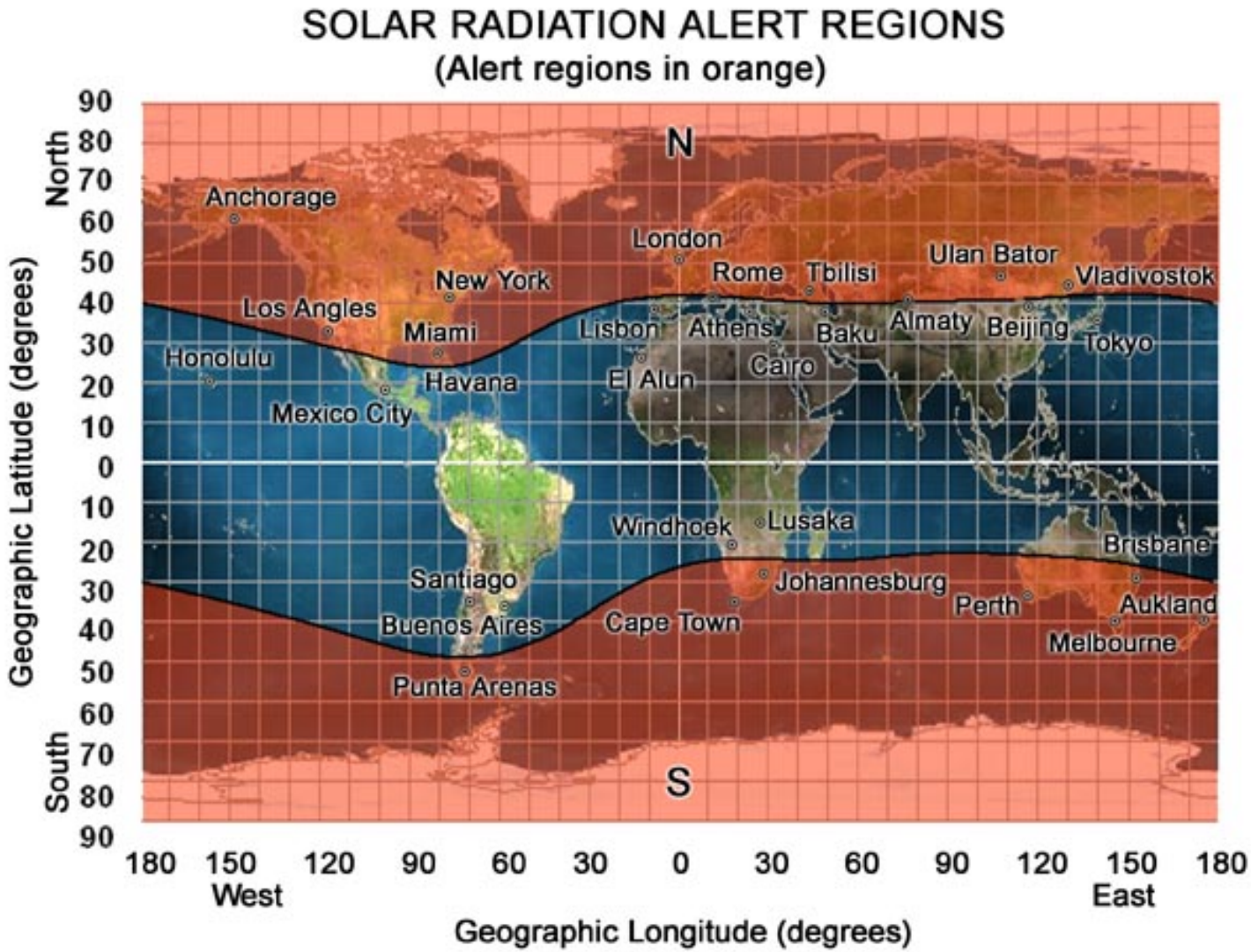

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- The airline industry agrees that the information on solar radiation is beneficial.
- The industry is also wary of what, if any, type of regulatory issues may arise from these alerts.
  - Discussions are underway to resolve these issues.